Process for treating a material by extrusion and an apparatus for producing a composite food product

BACKGROUND OF THE INVENTION

The present invention relates to an improved process for treating a material by extrusion, an apparatus for carrying out the process and also products produced by the process.

Extrusion machines are employed for effecting various treatments carried out on very varied materials. For example, there may be effected in screw machines treatments for preparing and employing food products, for example by a cooking-extrusion process.

Generally, a screw extrusion machine comprises an elongated sleeve surrounding at least one screw driven in rotation on which treating means are fixed,such as screw-threads extending in a helix around the axis. In the case of an extrusion machine having a plurality of screws having parallel axes, the screws are placed within intersecting bores formed in the sleeve and having diameters exceeding the distance between the axes so that the material fed through an inlet orifice placed adjacent an upstream end of the sleeve is driven toward the downstream end by the combined effects of the rotation of the screws. The screwthreads may have sections with a varied pitch which permits effecting, in the direction toward the

downstream end, various treatments such as the mixing of the constituents introduced through the inlet orifice, the kneading of the material, the cooking in a thin layer in the case of food products; as the sleeve may be provided in certain sections with heating jackets or cooling jackets the product driven by the screws may be brought to or maintained at a given temperature.

But the continuous production of a composite food product, i.e. a product comprising a plurality of regions which are coloured and/or aromatized in a different manner, from a single material treated in an extrusion machine, poses problems in particular as concerns the injection of the various colouring and aromatizing agents, and also as concerns the formation of these different regions in a single product.

SUMMARY OF THE INVENTION

Now, investigations which have lead to the invention have shown that it was possible to obtain this type of new products having characteristics of particular interest.

According to the present invention, there is provided a process for treating a material by extrusion in a machine comprising at least one screw driven in rotation within an elongated sleeve and provided with helical threads which drive toward the downstream end of the machine the material introduced through an inlet orifice placed adjacent to the upstream end of the sleeve, comprising causing the material to pass through the outlet of a first treatment region into a second treatment region defined by a second sleeve, dividing said material into a plurality of independent fluxes, subjecting each flux to a particular treatment, and then conveying the independent fluxes into a third region and forming a final single product.

The invention permits the preparation of a product in the desired manner, for example by a cooking-extrusion process, in the first treatment region, and then the separation of the product into a plurality of fluxes which are mixed with different aromas or colouring agents in the separate bores of the second region.

But the invention also permits dividing a product previously prepared in the first treatment region into a plurality of fluxes which are subjected, for example, to different chemical reactions for achieving, for example, an expansion or a reduction of the product or for providing textures of different nature.

According to the present invention, there is also provided an apparatus for producing a composite food product by extrusion, comprising a machine including an elongated sleeve having an upstream inlet orifice and a downstream outlet orifice, a screw driven in rotation inside the elongated sleeve and provided with helical threads for driving the material introduced through the inlet orifice toward the downstream end, said apparatus further comprising a second part for treating the material and comprising a second sleeve defining separate bores for forming a plurality of independent fluxes of material, a common convergent portion, and a third part formed by an extrusion die having a central extrusion conduit of given length and section and put in communication with said separate bores through said convergent portion.

According to the present invention, there is also provided an apparatus for producing a composite food product by extrusion comprising a machine including an elongated sleeve having an upstream inlet orifice and a downstream end, at least two screws having parallel axes and each formed by a central driving shaft and helical threads disposed within said sleeve, the material being fed through

the inlet orifice and then driven toward the downstream end of the sleeve by the rotation fo the screws, said apparatus further comprising a second part for treating the material and comprising a second sleeve defining separate bores for forming a plurality of independent fluxes of material centered on axes of the screws, said screws being each extended inside the corresponding bore by a downstream portion acting as a mono-screw and provided with threads, and each of said bores of the second part opening into a third part formed by an extrusion die.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be better understood from the detailed description of several embodiments given by way of example and shown in the accompanying drawing. In the drawing:

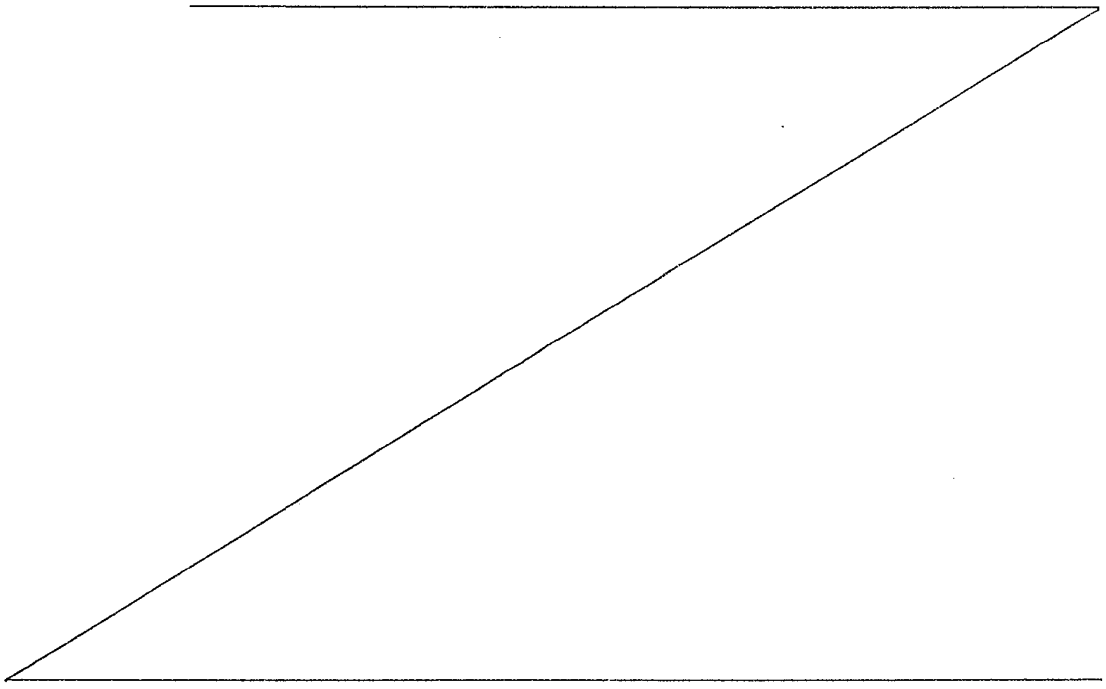

Fig. 1 is a diagrammatic axial sectional view of a first embodiment of the invention ;

Fig. 2 is a diagrammatic axial sectional view of a second embodiment of the invention ;

Figs. 3 and 4 are two cross-sectional views in planes A-A and B-B of Fig. 2 ;

Figs. 5 and 6 are modifications of the construction of the extrusion die ;

Figs. 7 and 8 are cross-sectional views of two examples of products produced by the process according to the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 shows diagrammatically an apparatus for carrying out the process according to the invention and formed by a machine having a plurality of treatment regions.

The upstream region I comprises a conventional screw extrusion machine. It therefore comprises an elongated sleeve 1 in which there is placed a screw 20 driven in rotation by a motor-speed reducer unit 3. The screw 20 is formed by a central driving shaft 21 on which a screw-thread 22 extends in the form of a helix. The pitch and the depth of the thread 22 are determined in accordance with the treatment it is desired to effect on the material introduced through a supply orifice 4 formed at the upstream end of the sleeve and driven toward the downstream end by the rotation of the screw 20.

Further, in a given section of the sleeve 1, the latter may be surrounded by a jacket (not shown) whereby it is possible to heat or cool and consequently bring the material to a desired temperature or regulate this temperature.

The upstream region I is followed by a second region II in which separate treatments may be carried out.

For this purpose, the sleeve 1 is extended by a second sleeve 5 in which are formed two separate bores 50 and 51 for forming two independent fluxes A and B of the material prepared in the region I. The sleeve 5 is provided with two orifices 52 and 53 opening onto the two bores 50 and 51 and permitting the introduction of different products in the two fluxes of material A and B. It is also possible to place in one or both bores 50 and 51, a static mixer 54 for homogeneizing the corresponding flux of material. The bores 50, 51 terminate in a common convergent portion which terminates in a single orifice 7.

This second treatment region II is followed by a third region III formed by an extrusion die 6 provided with a central extrusion conduit 60. The latter has a length which is so determined that the fluxes A and B are applied against each other and become unitary, as will be seen hereinafter.

Owing to this arrangement, the material fed through the inlet orifice 4 is subjected to the required treatment in the first region I of the machine and is then divided

into two independent fluxes A and B in the second region II. This second region permits the application of different treatments to the two fluxes coming from the same material and, in particular, the introduction through orifices 52 and 53 of colouring agents and/or different aromas or flavourings, the static mixer 54 thus homogeneizing the mixture.

Thereafter, after the two fluxes A and B have been subjected to a different treatment, they are conveyed through the convergent portion 55 to the extrusion conduit of the extrusion die 6 where they are grouped together into a single flux. At the outlet of the die 6, the material issues at a certain pressure and is subjected to atmospheric pressure and the shock due to this sudden pressure difference brings about an expansion of the material.

In the extrusion conduit 60, the two fluxes A and B are maintained applied against each other throughout the length of said conduit so as to achieve the adhesion of these two fluxes and obtain continuously at the outlet of the die a final product having on its transversely extending end and throughout the length, two coloured and/or aromatized regions of different types as shown in Fig. 7 in which the two fluxes A and B are shown adhered to each other.

The interconnection of the two fluxes is achieved, on one hand, owing to the symmetrical flow in the second

zone II of the fluxes A and B which are maintained at the same velocity and at the same temperature so as to retain the same characteristics of the material and, on the other hand, owing to the length of the extrusion conduit 60, which, during a given period of time, exerts sufficient pressure on these two fluxes.

Fig. 2 shows a second embodiment of the invention in which the upstream region I is formed by a conventional double-screw extrusion machine. It also has an elongated sleeve 1 in which are placed two screws 30 and 40 driven in rotation about their parallel axes by a motor-speed reducer unit 3. Each screw is formed by a central driving shaft 31, 41 on which extend helical screwthreads 32 and 42 which engage with each other. The two screws may be formed by successive sections having different pitches so that it is possible to subject the material, introduced through the supply orifice 4 provided at the upstream end of the sleeve and driven toward the downstream end by the rotation of the screws, to varied treatments.

As can be seen in Fig. 3, the sleeve 1 is provided with two bores 1a and 1b of diameters equal, apart from clearance, to the diameter of the two screws and consequently greater than the distance a between the axes, the two bores being therefore intersecting in a median region corresponding to the interengagement of the two screws.

Further, in a given section of the sleeve 1, the latter may be surrounded by a jacket for heating or cooling and consequently for bringing the material to a desired temperature or regulating the latter.

Depending on the contour given to the two screws, any known treatment of the material may be carried out within the section I of the machine. The upstream region I is also followed by a second region II in which separate treatments may be carried out. The sleeve 1 is therefore extended by a second sleeve 5 in which are formed two separate bores 50 and 51 for forming two independent fluxes A and B of the material prepared in the region I. The sum of the radii of the two separate bores 50 and 51 is less than the distance a between the axes of the two screws. Consequently, as shown in Fig. 4, the two bores 50 and 51 do not intersect.

The two screws 30 and 40 are each extended in the corresponding bore 50, 51 by a downstream portion 33, 43 respectively, which is mounted in the corresponding bore 50, 51. Each screw 33, 43 is formed by a shaft, 34 and 44 respectively, on which extends a helical screwthread 35 and 45 respectively. The two shafts 34, 44 are placed in the extension of the shafts 31, 41 of the two screws 30, 40 and driven in rotation with the latter. The threads 35, 45 have diameters which are equal, apart from clearance, to the diameters of the bores 50 and 51. As in the foregoing embodiment, the sleeve 5 is provided with two orifices 52 and 53

opening into the two bores 50 and 51 for introducing various additives in the two fluxes A and B of material.

Further, each bore 50, 51 is extended by a convergent portion 56 and 57 which terminate in an orifice 8 and 9 respectively. Each screw 33, 43 is provided with a pointed portion which enters the corresponding convergent portion.

The treatment region II formed by the sleeve 5 is followed by a third region III formed by an extrusion die 6a. The latter comprises for each flux A and B, in front of each orifice 8, 9, a distribution passageway 61 and 62 respectively, which are symmetrical to each other and converge to a common extrusion conduit 60a.

In this embodiment employing a double-screw machine, the material fed through the inlet orifice 4 is subjected to the desired treatment in the first region I and is then divided in the region II into two independent fluxes A and B driven by the screws 33, 43 which operate as a mono-screw. This second region II permits the introduction through the orifices 52 and 53 of different colouring agents and/or aromas or flavourings, the screws 33 and 43 homogeneizing the mixture in each flux.

Thereafter, when the two fluxes A and B have been subjected to a different treatment, they are conveyed by the convergent portions 56, 57 to the distribution passageways 61, 62 and then they are re-grouped into a single flux in the extrusion conduit 60a of the extrusion die 6a. In this conduit 60a, the two fluxes A and B become unitary for the

previously explained reasons.

There is thus obtained from a single material treated in a double-screw machine, a final product comprising two differently coloured and/or aromatized regions.

Owing to the invention, it is also possible to arrange that the two mono-screws 44, 43 lead to concentric extrusion dies (Fig. 5) which permit the production of a filled product by co-extrusion.

In this embodiment, the third region III is formed by an extrusion die 70 having, for each flux A and B, in front of each orifice 8, 9, a distribution passageway 71 and 72 respectively. Each distribution passageway 71 and 72 communicates with an extrusion conduit 73 and 74, the conduit 74 being concentric with the conduit 73. The flux A is therefore conveyed by the distribution passageway 71 to the conduit 73 so as to form the external material of the product, while the flux B is conveyed by the passageway 72 to the conduit 74 for forming the filling of the product. Thus, it can be seen that, with the use of the same starting material, it will be possible to produce a product, as shown in Fig. 8, having a filling and a covering which are different as concerns their taste, their texture, or their appearance.

In order to increase the delivery or flow of the final product, the extrusion die may obviously include a plurality of extrusion conduits, as shown in Fig. 6. In this case, in respect of each flux A and B, the distribution passageways

11 and 12 of the extrusion die 10 are divided into sub-passageways 11a, 11b and 12a, 12b respectively, which converge in pairs toward an extrusion conduit 13, 14. The path of flow of each flux A and B in the passageways and the sub-passageways is symmetrical.

The machines described hereinbefore may be completed by a device for cutting the extruded products. The section of the extrusion dies may be varied for extruding products of different shapes. Further, the material issuing from the first treatment region may be also separated into a plurality of independent fluxes which are subjected to different treatments, these fluxes being thereafter re-grouped in a single extrusion conduit so as to provide a final product having, on the transverse end and throughout the length thereof, a plurality of differently coloured and/or aromatized sectors.

Owing to the invention, it is thus possible to extrude in the same machine and from the same material a composite food product without necessity to produce the different elements thereof separately or to employ a plurality of machines.

Various modifications and improvements may be made in the process and apparatus according to the invention within the scope of the accompanying claims.